



## TEST REPORT

Test report no.: 1-4299\_22-02-03

BNetzA-CAB-02/21-102

### Testing laboratory

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#### Accredited Testing Laboratory:

The testing laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025 (2018-03) by the Deutsche Akkreditierungsstelle GmbH (DAKKS). The accreditation is valid for the scope of testing procedures as stated in the accreditation certificate starting with the registration number: D-PL-12076-01.

### Applicant

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### Manufacturer

**Elektroniksystem i Umeå AB**  
Tvistevägen 48  
90736 Umeå / SWEDEN

### Test standard/s

FCC - Title 47 CFR Part 15      FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices

RSS - 247 Issue 2                Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence - Exempt Local Area Network (LE-LAN) Devices

For further applied test standards please refer to section 3 of this test report.

### Test Item

**Kind of test item:**                LoRa Device  
**Model name:**                    ERS-2  
**FCC ID:**                            2ANX3-ERS02  
**ISED certification number:**    26904-ERS02  
**Frequency:**                        902 MHz to 928 MHz  
**Technology tested:**                LoRa  
**Antenna:**                            Integrated antenna  
**Power supply:**                    3.0 V DC by batteries  
**Temperature range:**                -40°C to +85°C

This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

### Test report authorized:

Marco Bertolino  
Supervisor Radio Services  
Radio Labs

### Test performed:

Michael Dorongovski  
Lab Manager  
Radio Labs

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## 2 General information

### 2.1 Notes and disclaimer

The test results of this test report relate exclusively to the test item specified in this test report. cetecom advanced GmbH does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.

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In no case this test report can be considered as a Letter of Approval.

This test report is electronically signed and valid without handwritten signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

### 2.2 Application details

Date of receipt of order:	2023-05-03
Date of receipt of test item:	2023-06-15
Start of test:*	2023-06-19
End of test:*	2023-07-10
Person(s) present during the test:	-/-

\*Date of each measurement, if not shown in the plot, can be requested. Dates are stored in the measurement software.


### 2.3 Test laboratories sub-contracted

None

### 3 Test standard/s, references and accreditations

Test standard	Date	Description
FCC - Title 47 CFR Part 15	-/-	FCC - Title 47 of the Code of Federal Regulations; Chapter I; Part 15 - Radio frequency devices
RSS - 247 Issue 2	February 2017	Digital Transmission Systems (DTs), Frequency Hopping Systems (FHSs) and Licence - Exempt Local Area Network (LE-LAN) Devices
RSS - Gen Issue 5 incl. Amendment 1 & 2	February 2021	Spectrum Management and Telecommunications Radio Standards Specification - General Requirements for Compliance of Radio Apparatus

Guidance	Version	Description
KDB 558074 D01	v05r02	GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES
ANSI C63.4-2014	-/-	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10-2013	-/-	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

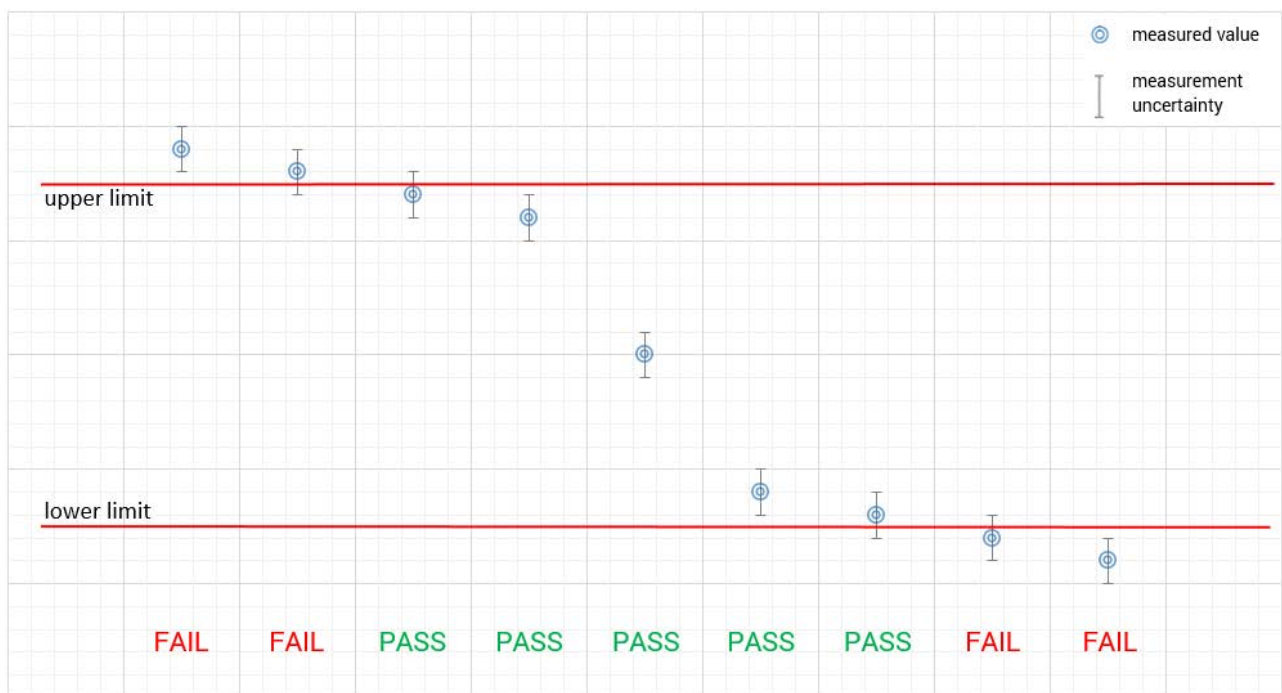
Accreditation	Description	
D-PL-12076-01-04	Telecommunication and EMC Canada <a href="https://www.dakks.de/as/ast/d/D-PL-12076-01-04e.pdf">https://www.dakks.de/as/ast/d/D-PL-12076-01-04e.pdf</a>	 
D-PL-12076-01-05	Telecommunication FCC requirements <a href="https://www.dakks.de/as/ast/d/D-PL-12076-01-05e.pdf">https://www.dakks.de/as/ast/d/D-PL-12076-01-05e.pdf</a>	 

ISED Testing Laboratory Recognized Listing Number: DE0001  
FCC designation number: DE0002

#### 4 Reporting statements of conformity – decision rule

Only the measured values related to their corresponding limits will be used to decide whether the equipment under test meets the requirements of the test standards listed in chapter 3. The measurement uncertainty is mentioned in this test report, see chapter 9, but is not taken into account - neither to the limits nor to the measurement results. Measurement results with a smaller margin to the corresponding limits than the measurement uncertainty have a potential risk of more than 5% that the decision might be wrong."

measured value, measurement uncertainty, verdict



## 5 Test environment

Temperature	:	$T_{nom}$ $T_{max}$ $T_{min}$	+22 °C during room temperature tests No tests under extreme environmental conditions required. No tests under extreme environmental conditions required.
Relative humidity content	:		50 %
Barometric pressure	:		1021 hpa
Power supply	:	$V_{nom}$ $V_{max}$ $V_{min}$	3.0 V DC by batteries No tests under extreme environmental conditions required. No tests under extreme environmental conditions required.

## 6 Test item

### 6.1 General description

Kind of test item	:	LoRa Device	
Model name	:	ERS-2	
HMN	:	-/-	
PMN	:	ERS2, ERS2-lite, ERS2-CO2, ERS2-EYE, ERS2-Sound, ERS2-VOC, ERS2-CO2lite	
HVIN	:	6	
FVIN	:	3	
S/N serial number	:	Rad.	A81758FFFE09D2A3
		Cond.	A81758FFFE09D2A6
Hardware status	:	6	
Software status	:	3	
Firmware status	:	NA	
Frequency band	:	902 MHz to 928 MHz	
Type of radio transmission	:	DTS	
Use of frequency spectrum	:		
Type of modulation	:	O-QPSK	
Number of channels	:	8	
Antenna	:	Integrated antenna	
Power supply	:	3.0 V DC by batteries	
Temperature range	:	-40°C to +85°C	

### 6.2 Additional information

The content of the following annexes is defined in the QA. It may be that not all of the listed annexes are necessary for this report, thus some values in between may be missing.

Test setup and EUT photos are included in test report:

- 1-4299\_22-02-01\_AnnexA
- 1-4299\_22-02-01\_AnnexB
- 1-4299\_22-02-01\_AnnexD

## 7 Sequence of testing

### 7.1 Sequence of testing radiated spurious 9 kHz to 30 MHz

#### Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, it is placed on a table with 0.8 m height.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

#### Premeasurement\*

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna height is 1 m.
- At each turntable position the analyzer sweeps with positive-peak detector to find the maximum of all emissions.

#### Final measurement

- Identified emissions during the pre-measurement are maximized by the software by rotating the turntable from 0° to 360°.
- Loop antenna is rotated about its vertical axis for maximum response at each azimuth about the EUT. (For certain applications, the loop antenna plane may also need to be positioned horizontally at the specified distance from the EUT)
- The final measurement is done in the position (turntable and elevation) causing the highest emissions with quasi-peak (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. A plot with the graph of the premeasurement and the limit is stored.

\*Note: The sequence will be repeated three times with different EUT orientations.

## 7.2 Sequence of testing radiated spurious 30 MHz to 1 GHz

### Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 10 m or 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

### Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 m to 3 m.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

### Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable position  $\pm 45^\circ$  and antenna height between 1 and 4 m.
- The final measurement is done with quasi-peak detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.



### 7.3 Sequence of testing radiated spurious 1 GHz to 18 GHz

#### Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer.
- If the EUT is a tabletop system, a 2-axis positioner with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C 63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measurement distance is 3 m (see ANSI C 63.4) – see test details.
- EUT is set into operation.

#### Premeasurement

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height is 1.5 m.
- At each turntable position and antenna polarization the analyzer sweeps with positive peak detector to find the maximum of all emissions.

#### Final measurement

- The final measurement is performed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximizes the peaks by rotating the turntable from 0° to 360°. This measurement is repeated for different EUT-table positions (0° to 150° in 30°-steps) and for both antenna polarizations.
- The final measurement is done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and RMS detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit are recorded. A plot with the graph of the premeasurement with marked maximum final results and the limit is stored.

## 8 Description of the test setup

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Weekly chamber inspections and range calibrations are performed. Where possible, RF generating and signaling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

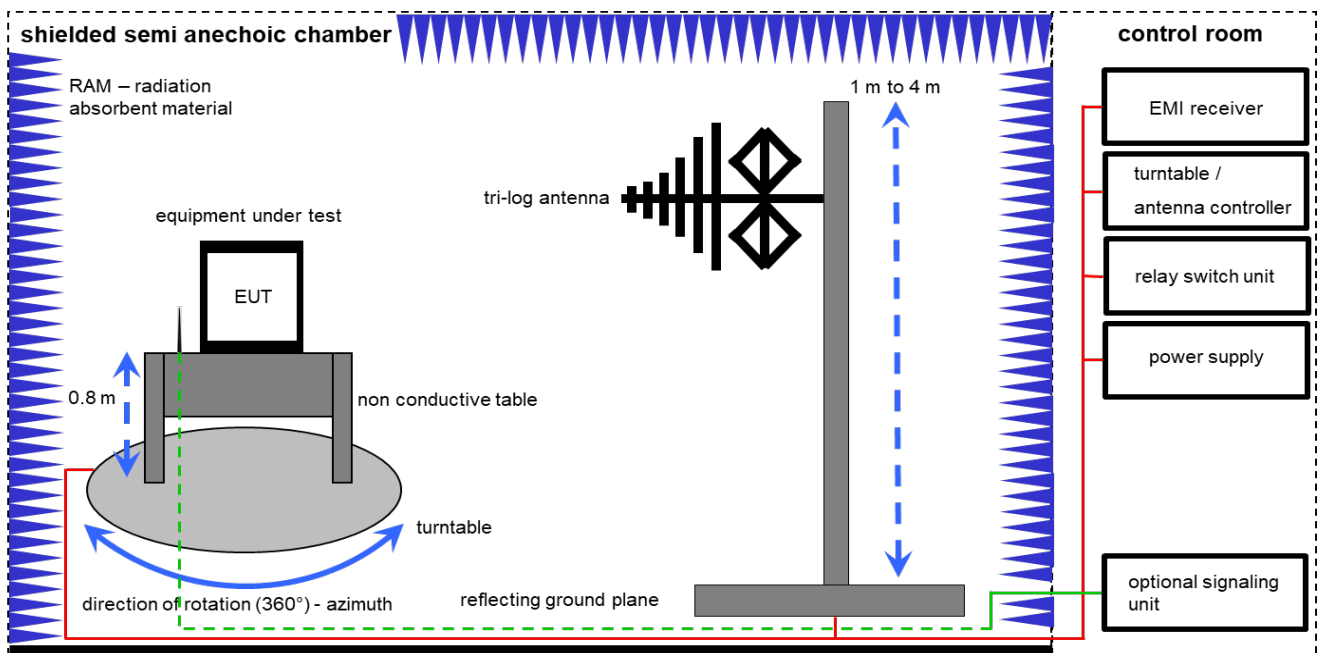
Each block diagram listed can contain several test setup configurations. All devices belonging to a test setup are identified with the same letter syntax. For example: Column Setup and all devices with an A.

### **Agenda:** Kind of Calibration

k	calibration / calibrated	EK	limited calibration
ne	not required (k, ev, izw, zw not required)	zw	cyclical maintenance (external cyclical maintenance)
ev	periodic self verification	izw	internal cyclical maintenance
Ve	long-term stability recognized	g	blocked for accredited testing
vlk!	Attention: extended calibration interval		
NK!	Attention: not calibrated	*)	next calibration ordered / currently in progress

## 8.1 Shielded semi anechoic chamber

The radiated measurements are performed in vertical and horizontal plane in the frequency range from 30 MHz to 1 GHz in semi-anechoic chambers. The EUT is positioned on a non-conductive support with a height of 0.80 m above a conductive ground plane that covers the whole chamber. The receiving antennas are conform to specifications ANSI C63. These antennas can be moved over the height range between 1.0 m and 4.0 m in order to search for maximum field strength emitted from EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by spectrum analyzers where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Measurement distance: tri-log antenna 10 meter; EMC32 software version: 10.59.00

FS = UR + CL + AF

(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

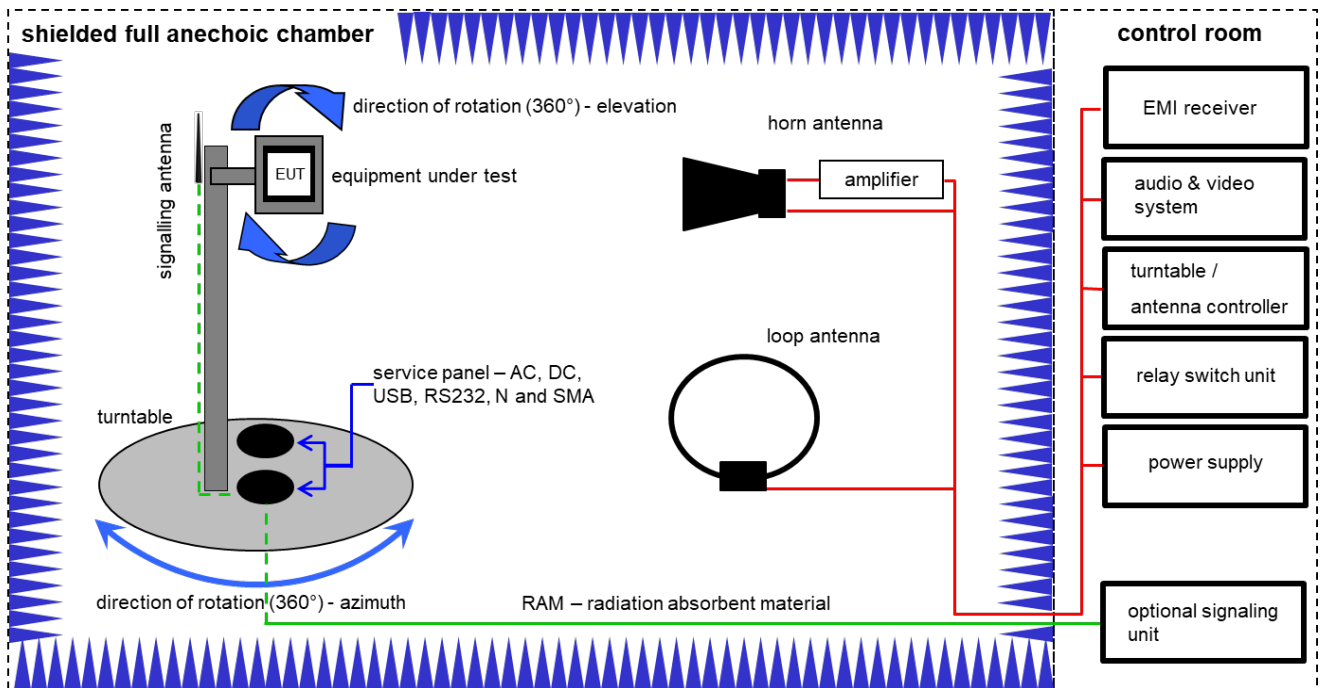
Example calculation:

FS [dB $\mu$ V/m] = 12.35 [dB $\mu$ V/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dB $\mu$ V/m] (35.69  $\mu$ V/m)

### Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Switch-Unit	3488A	HP	2719A14505	300000368	ev	-/-	-/-
2	A	Semi anechoic chamber	3000023	MWB AG	-/-	300000551	ne	-/-	-/-
3	A	Antenna Tower	Model 2175	ETS-Lindgren	64762	300003745	izw	-/-	-/-
4	A	Positioning Controller	Model 2090	ETS-Lindgren	64672	300003746	izw	-/-	-/-
5	A	Turntable Interface-Box	Model 105637	ETS-Lindgren	44583	300003747	izw	-/-	-/-
6	A	TRILOG Broadband Test-Antenna 30 MHz - 3 GHz	VULB9163	Schwarzbeck Mess-Elektronik	318	300003696	vKI!	30.09.2021	29.09.2023
7	A	Turntable	2089-4.0	EMCO	-/-	300004394	ne	-/-	-/-
8	A	PC	Tecline	F+W	-/-	300004388	ne	-/-	-/-
9	A	EMI Test Receiver	ESR3	Rohde & Schwarz	102587	300005771	k	09.12.2022	31.12.2023

## 8.2 Shielded fully anechoic chamber



Measurement distance: horn antenna 3 meter; loop antenna 3 meter / 1 meter

$$FS = UR + CA + AF$$

(FS-field strength; UR-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

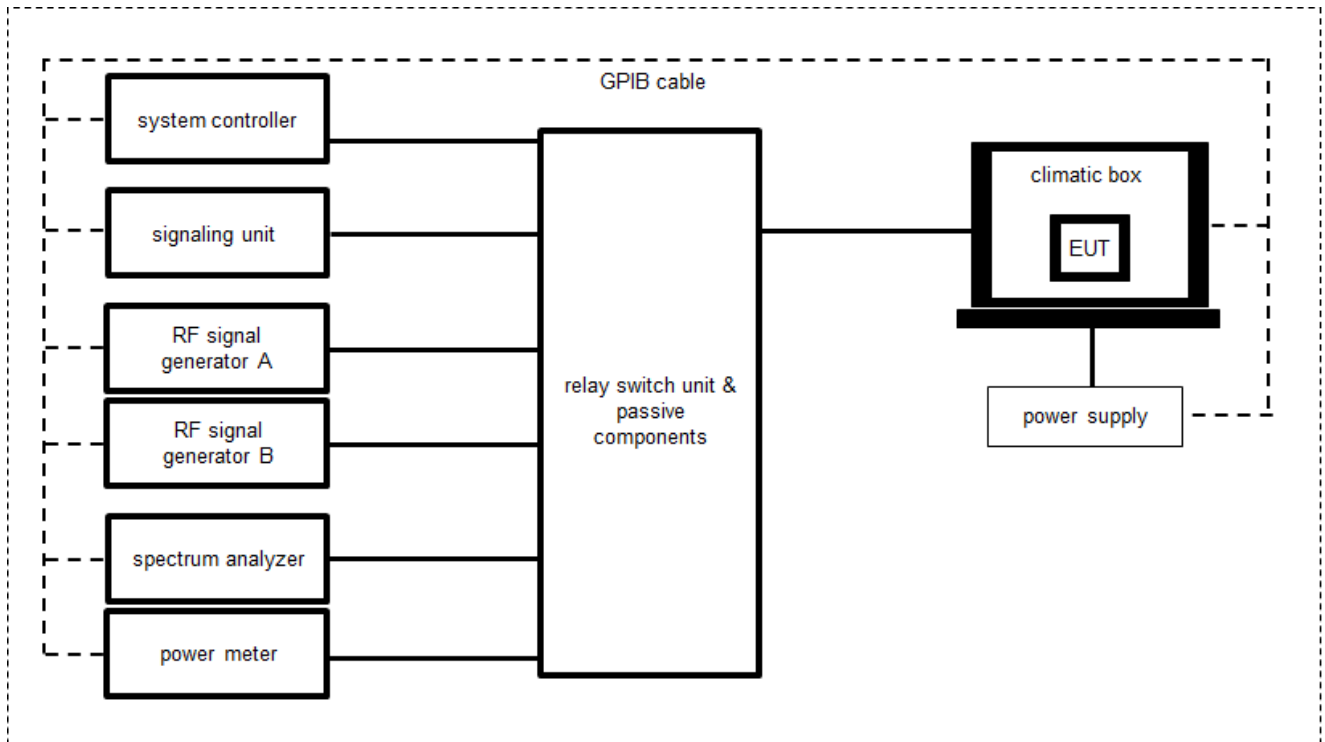
Example calculation:

$$FS [dB\mu V/m] = 40.0 [dB\mu V/m] + (-35.8) [dB] + 32.9 [dB/m] = 37.1 [dB\mu V/m] (71.61 \mu V/m)$$

### Equipment table:

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A, B	Double-Ridged Waveguide Horn Antenna 1-18.0GHz	3115	EMCO	8812-3088	300001032	vKI!	02.08.2021	31.08.2023
2	C	Active Loop Antenna 9 kHz to 30 MHz	6502	EMCO	2210	300001015	vKI!	01.07.2021	31.07.2023
3	B	Highpass Filter	WHKX7.0/18G-8SS	Wainwright	18	300003789	ne	-/-	-/-
4	A, B, C	Broadband Amplifier 0.5-18 GHz	CBLU5184540	CERNEX	22051	300004483	ev	-/-	-/-
5	A, B, C	4U RF Switch Platform	L4491A	Agilent Technologies	MY50000032	300004510	ne	-/-	-/-
6	A, B, C	Computer	Intel Core i3 3220/3,3 GHz, Prozessor	-/-	2V2403033A54 21	300004591	ne	-/-	-/-
7	A, B, C	NEXIO EMV-Software	BAT EMC V2022.0.22.0	Nexio	-/-	300004682	ne	-/-	-/-
8	A, B, C	Anechoic chamber	-/-	TDK	-/-	300003726	ne	-/-	-/-
9	A, B, C	EMI Test Receiver 9kHz-26,5GHz	ESR26	Rohde & Schwarz	101376	300005063	k	13.12.2022	31.12.2023
10	B	RF-Amplifier	AMF-6F06001 800-30-10P-R	NARDA-MITEQ Inc	2011571	300005240	ev	-/-	-/-

### 8.3 Conducted measurements system



OP = AV + CA  
 (OP-output power; AV-analyzer value; CA-loss signal path)

Example calculation:

OP [dBm] = 6.0 [dBm] + 11.7 [dB] = 17.7 [dBm] (58.88 mW)

**Equipment table:**

No.	Setup	Equipment	Type	Manufacturer	Serial No.	INV. No.	Kind of Calibration	Last Calibration	Next Calibration
1	A	Switch / Control Unit (including DC-Block, Splitter)	3488A	HP	-/-	300000929	ne	-/-	-/-
2	A	Hygro-Thermometer	-/, 5-45C, 20-100rF	Thies Clima	-/-	400000080	ev	15.09.2022	14.09.2024
3	A	Signal analyzer	FSV30	Rohde&Schwarz	1321.3008K30/103170	300004855	vKI!	09.12.2022	31.12.2024
4	A	USB-GPIB-Interface	82357B	Agilent Technologies	MY54323070	300004852	ne	-/-	-/-
5	A	Tester Software C.BER	Version 5.0	CTC advanced GmbH	0001	400001379	ne	-/-	-/-
6	A	Switch matrix	RSM 1.1	CTC advanced GmbH	31534892	400001456	ev	20.09.2022	19.09.2023

## 9 Measurement uncertainty

Measurement uncertainty	
Test case	Uncertainty
Antenna gain	± 3 dB
Carrier frequency separation	± 21.5 kHz
Number of hopping channels	-/-
Spectrum bandwidth	± 21.5 kHz absolute; ± 15.0 kHz relative
Maximum output power	± 1 dB
Detailed conducted spurious emissions @ the band edge	± 1 dB
Band edge compliance radiated	± 3 dB
Spurious emissions conducted	± 3 dB
Spurious emissions radiated below 30 MHz	± 3 dB
Spurious emissions radiated 30 MHz to 1 GHz	± 3 dB
Spurious emissions radiated 1 GHz to 12.75 GHz	± 3.7 dB
Spurious emissions radiated above 12.75 GHz	± 4.5 dB

## 10 Summary of measurement results

<input checked="" type="checkbox"/>	No deviations from the technical specifications were ascertained
<input type="checkbox"/>	There were deviations from the technical specifications ascertained
<input type="checkbox"/>	This test report is only a partial test report. The content and verdict of the performed test cases are listed below.

Test specification clause	Test case	Temperature conditions	Power source voltages	Mode	C	NC	NA	NP	Remark
§15.247(b)(4) RSS 210 / A8.4(2)	Antenna gain	Nominal	Nominal	TX single channel	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.247(e) RSS - 247 / 5.2 (b)	Power spectral density	Nominal	Nominal	TX single channel	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.247(a)(2) RSS Gen clause 4.6.1	Spectrum bandwidth 6dB bandwidth	Nominal	Nominal	TX single channel	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.247(b)(3) RSS - 247 / 5.4 (d)	Maximum output power	Nominal	Nominal	TX single channel	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.205 RSS - 247 / 5.5 RSS - Gen	Band edge compliance conducted	Nominal	Nominal	TX single channel	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.205 RSS - 247 / 5.5 RSS - Gen	Band edge compliance radiated	Nominal	Nominal	-/-	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§§15.247(d) RSS - 247 / 5.5	TX spurious emissions conducted	Nominal	Nominal	TX single channel	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.247(d) RSS-210 / A8.5	TX spurious emissions radiated	Nominal	Nominal	TX single channel	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	-/-
§15.209(a) RSS-Gen	TX spurious emissions radiated < 30 MHz	Nominal	Nominal	TX single channel	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	-/-

**Note:** C = Compliant; NC = Not compliant; NA = Not applicable; NP = Not performed

## 11 Additional comments

Reference documents: Test report no. 1-4299\_22-02-02  
1-4299\_22-02-03\_Annex\_MR

Special test descriptions: None

Configuration descriptions: DTS: 8 channels with 500 kHz nominal bandwidth and 1600 kHz channel spacing  
lowest channel 903.0 MHz,  
middle channel 909.4 MHz,  
highest channel 914.2 MHz;

Test mode:  Special software is used.  
EUT is transmitting pseudo random data by itself



## 12 Measurement results

### 12.1 Maximum output power

#### Measurement:

Measurement parameter	
External result file	1-4299_22-02-03_Annex_MR FCC 15.247 # Maximum peak conducted output power ~ Generic 0G9
Measurement method	According to ANSI C63.10-2013 11.9.1.1 Maximum peak conducted output power
Used equipment:	See chapter 8.3 A
Measurement uncertainty:	See chapter 9

#### Limits:

FCC	IC
1 watt (30 dBm) Maximum Output Power Conducted	

#### Result:

Test Conditions		Maximum Output Power Conducted / dBm		
		Low channel	Middle channel	High channel
$T_{nom}$	$V_{nom}$	14.4	14.3	14.3

## 12.2 Antenna gain

**Limits:**

FCC	IC
Antenna gain	
<p>The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.</p>	

**Results:** Extracted from test report no. 1-4299\_22-02-02

	Low channel	Middle channel	High channel
Gain / dBi (Calculated)	-0.9	-1.1	-1.5

## 12.3 Power spectral density

### Measurement:

Measurement parameter	
External result file	1-4299_22-02-03_Annex_MR FCC 15.247 # Peak power spectral density DTS ~ Generic 0G9
Measurement method	According to ANSI C63.10-2013 11.10.2 Method PKPSD
Test setup	See sub clause 8.3 A
Measurement uncertainty	See sub clause 9

### Limits:

FCC	IC
Power Spectral Density	
The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission or over 1.0 second if the transmission exceeds 1.0-second duration.	

### Results:

Modulation Channel	Power Spectral density / (dBm/3kHz)		
	Lowest	Middle	Highest
	-4.1	-4.2	-4.1

## 12.4 Spectrum bandwidth – 6 dB bandwidth and 99% bandwidth

### Measurement:

Measurement parameter	
External result file	1-4299_22-02-03_Annex_MR FCC 15.247 # Bandwidths ~ Generic 0G9
Measurement method	According to ANSI C63.10-2013 11.8 DTS bandwidth
Test setup	See sub clause 8.3 A
Measurement uncertainty	See sub clause 9

### Limits:

FCC	IC
Spectrum Bandwidth – 6 dB Bandwidth	
The minimum 6 dB bandwidth shall be at least 500 kHz.	

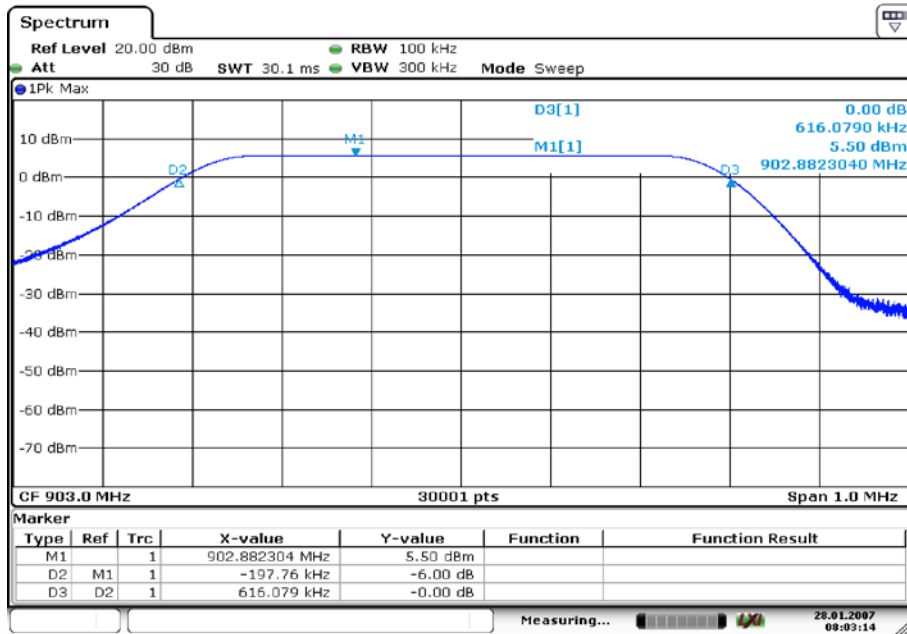
### Results:

Test Conditions		6 dB Bandwidth / kHz		
		Low channel	Middle channel	High channel
$T_{nom}$	$V_{nom}$	616	623	622

Test Conditions		99% Bandwidth / kHz		
		Low channel	Middle channel	High channel
$T_{nom}$	$V_{nom}$	500.5	506.4	505.5

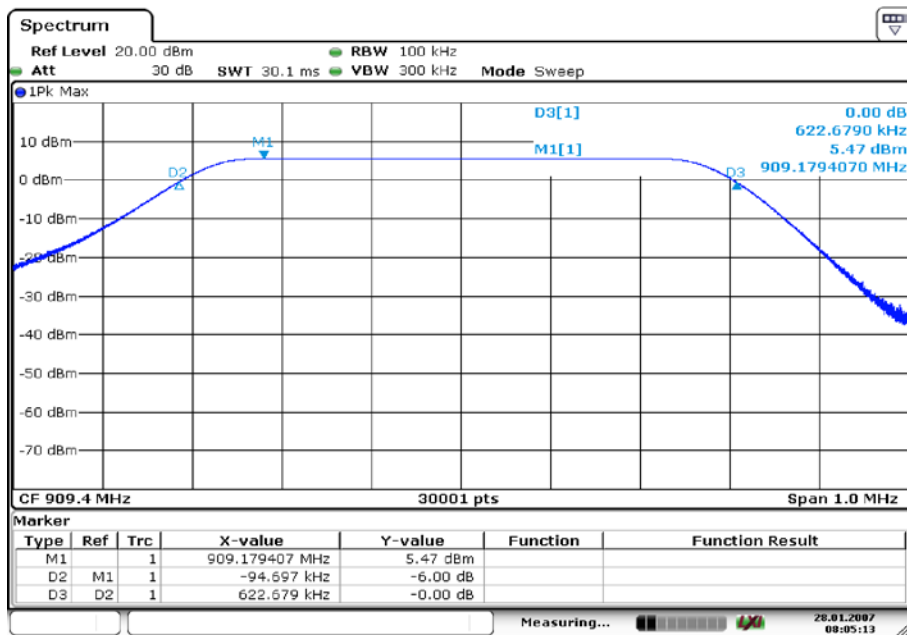
Plots: 6 dB bandwidth

Plot 1: lowest channel



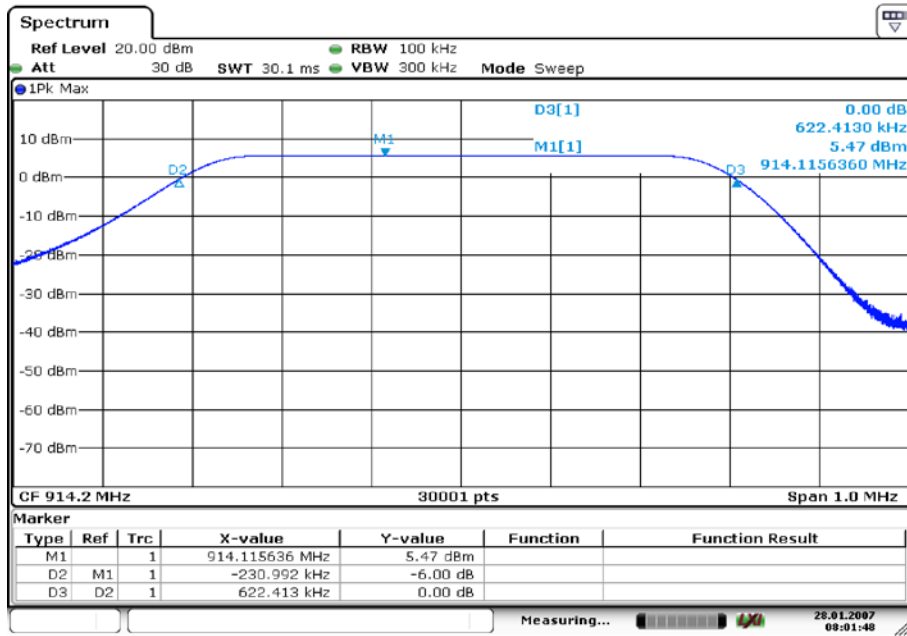
Date: 28. JAN 2007 08:03:15

Plot 2: middle channel



Date: 28. JAN 2007 08:05:13

Plot 3: highest channel



Date: 28. JAN 2007 08:01:48

## 12.5 Detailed spurious emissions @ the band edge – conducted and radiated

### Measurement:

Measurement parameters	
External result file	1-4299_22-02-03_Annex_MR FCC 15.247 # TX spurious conducted 20dBc ~ Generic 0G9
Test setup	See chapter 8.3 A
Measurement uncertainty	See chapter 9

### Limits:

FCC	IC
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.	

**Results: Compliant (See log file)**

## 12.6 Spurious Emissions Conducted

**Measurement:**

Measurement parameter	
External result file	1-4299_22-02-03_Annex_MR FCC 15.247 # TX spurious conducted 20dBc ~ Generic 0G9
Used equipment:	See chapter 8.3 A
Measurement uncertainty:	See chapter 9

**Limits:**

FCC	IC
TX spurious emissions conducted	
<p>In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required</p>	

**Results:** Compliant (See log file)



## 12.7 Spurious Emissions Radiated < 30 MHz

### Description:

Measurement of the radiated spurious emissions in transmit mode below 30 MHz. The EUT is set to single channel mode and the transmit channels are 00; 39 and 78. The measurement is performed in the mode with the highest output power. The limits are recalculated to a measurement distance of 3 m according the ANSI C63.10.

### Measurement:

Measurement parameter	
Detector:	Peak / Quasi Peak
Sweep time:	Auto
Video bandwidth:	F < 150 kHz: 1 kHz F > 150 kHz: 100 kHz
Resolution bandwidth:	F < 150 kHz: 200 Hz F > 150 kHz: 9 kHz
Span:	9 kHz to 30 MHz
Trace-Mode:	Max Hold
Used equipment:	See chapter 8.2 C
Measurement uncertainty:	See chapter 9

### Limits:

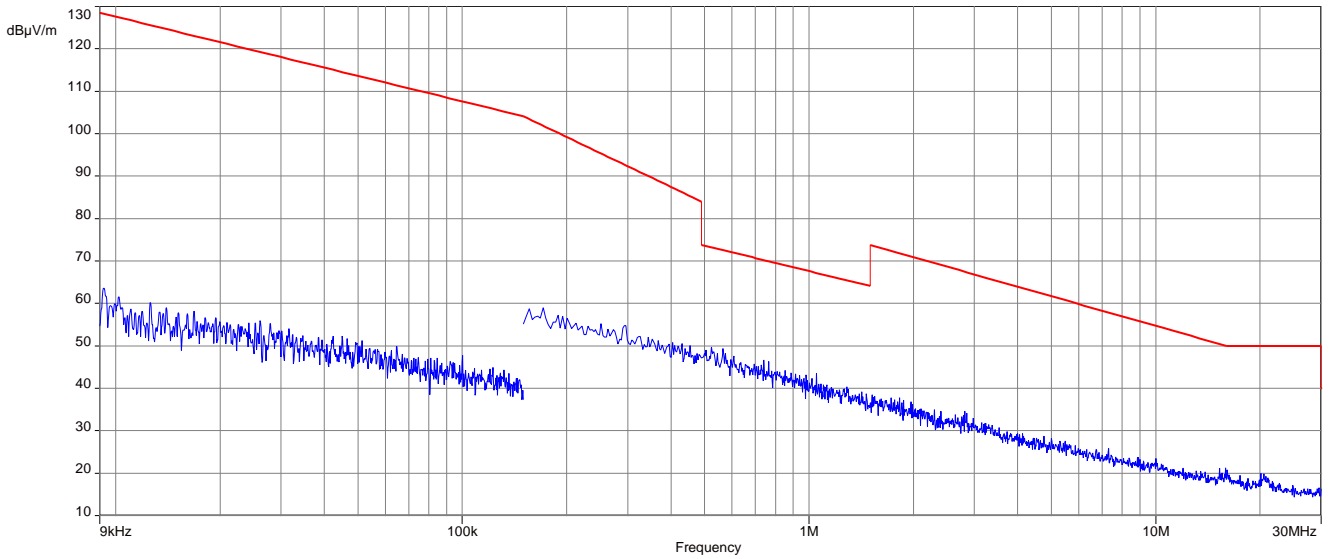
FCC		IC	
TX spurious emissions radiated < 30 MHz			
Frequency (MHz)	Field strength (dB $\mu$ V/m)	Measurement distance	
0.009 – 0.490	2400/F(kHz)	300	
0.490 – 1.705	24000/F(kHz)	30	
1.705 – 30.0	30	30	

### Result:

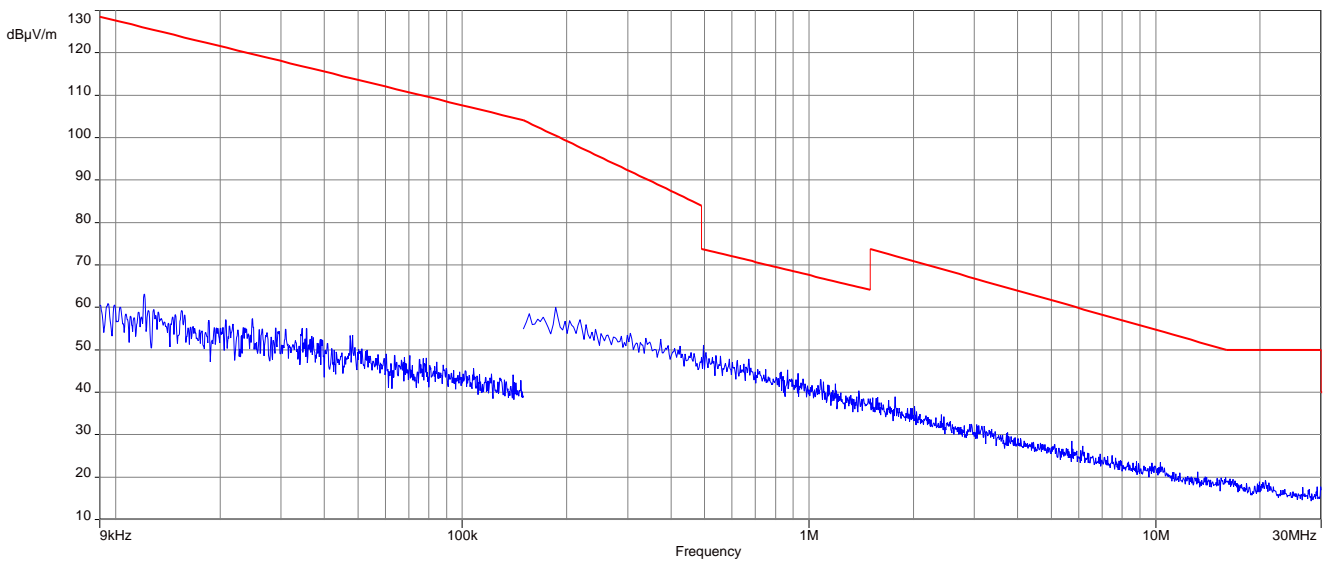
Spurious emission level								
Lowest channel			Lowest channel			Lowest channel		
Frequency / MHz	Detector	Level / (dB $\mu$ V/m)	Frequency / MHz	Detector	Level / (dB $\mu$ V/m)	Frequency / MHz	Detector	Level / (dB $\mu$ V/m)
No emissions detected.								

**Plots:**

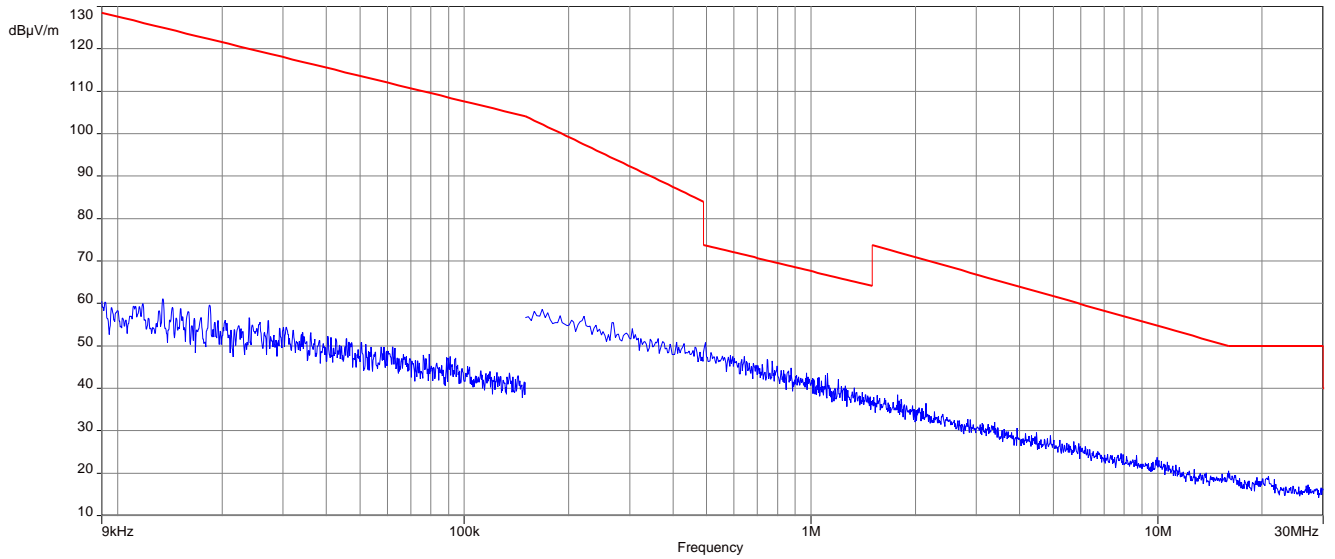
Plot 1: TX-Mode low channel



Plot 2: TX-Mode mid channel



Plot 3: TX-Mode high channel



## 12.8 Spurious emissions radiated 30 MHz to 1 GHz

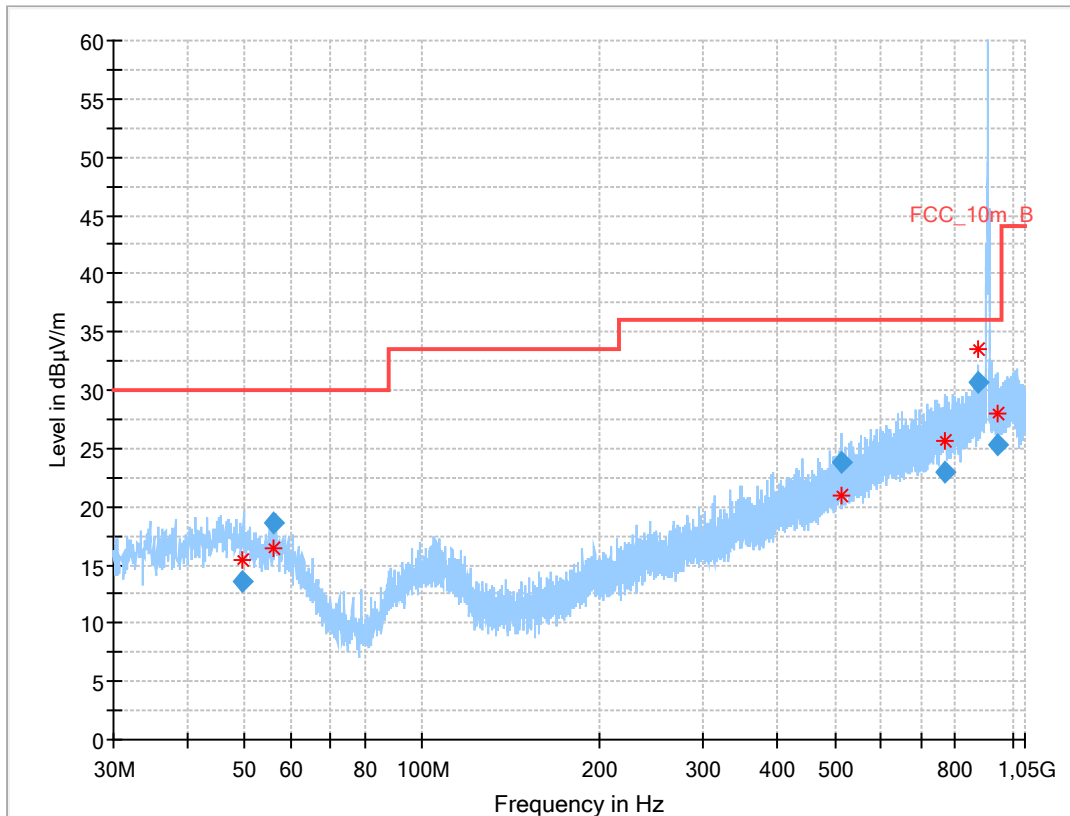
### Measurement:

Measurement parameters	
Detector	Peak / Quasi Peak
Sweep time	Auto
Resolution bandwidth	3 x VBW
Video bandwidth	120 kHz
Span	30 MHz to 1 GHz
Trace mode	Max hold
Measured modulation	DTS
Test setup	See sub clause 8.1 A
Measurement uncertainty	See sub clause 9

### Limits:

FCC	IC	
Band-edge Compliance of conducted and radiated emissions		
<p>In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).</p>		
Frequency / MHz	Field Strength / (dB $\mu$ V/m)	Measurement distance / m
30 - 88	30.0	10
88 - 216	33.5	10
216 - 960	36.0	10
Above 960	54.0	3

Plot 1: 30 MHz – 1 GHz, horizontal & vertical polarisation, valid for all channels



Final results:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
49.718	13.55	30.0	16.5	1000	120.0	195.0	V	16	16
56.178	18.60	30.0	11.4	1000	120.0	155.0	V	253	16
512.621	23.79	36.0	12.2	1000	120.0	183.0	H	232	20
769.280	22.93	36.0	13.1	1000	120.0	195.0	V	56	24
877.158	30.61	36.0	5.4	1000	120.0	101.0	H	170	25
942.693	25.36	36.0	10.6	1000	120.0	181.0	V	52	26

## 12.9 Spurious emissions radiated above 1 GHz

### Measurement:

Measurement parameters	
Detector	Peak / RMS
Sweep time	Auto
Resolution bandwidth	1 MHz
Video bandwidth	3 x RBW
Span	1 GHz to 10 GHz
Trace mode	Max hold
DSSS, FHSS Hybrid	DTS
Test setup	See sub clause 8.2 B
Measurement uncertainty	See sub clause 9

### Limits:

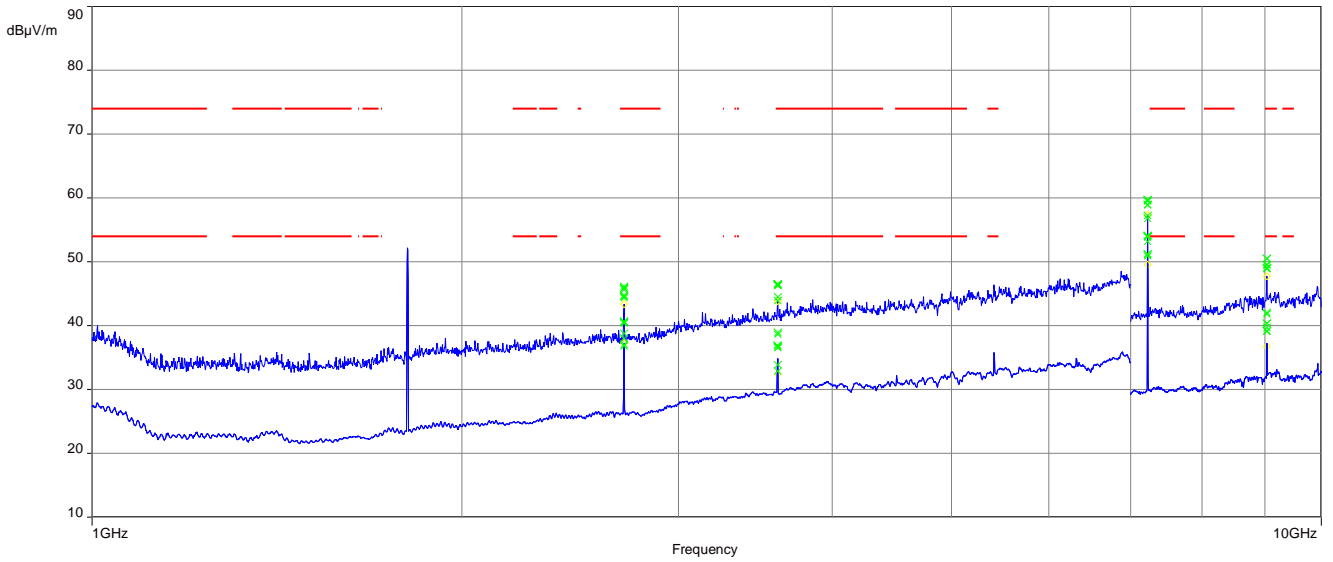
FCC	ISED	
TX spurious emissions radiated		
<p>In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).</p>		
§15.209		
Frequency (MHz)	Field strength (dB $\mu$ V/m)	Measurement distance
Above 960	54.0 (Average)	3
Above 960	74.0 (Peak)	3

**Result:**

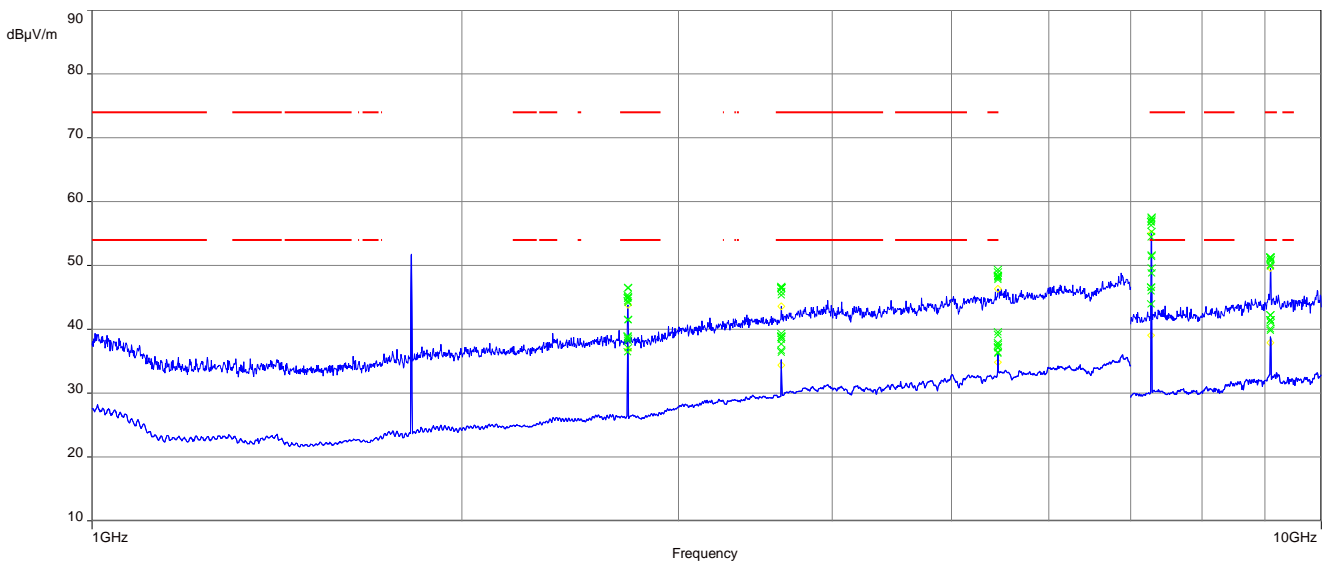
TX spurious emissions radiated								
Lowest channel			Middle channel			Highest channel		
Frequency / MHz	Detector	Level / (dBµV/m)	Frequency / MHz	Detector	Level / (dBµV/m)	Frequency / MHz	Detector	Level / (dBµV/m)
2709	Peak	46.2	2729	Peak	46.6	2743	Peak	47.2
	AVG	40.4		AVG	41.6		AVG	42.4
3612	Peak	46.6	3638	Peak	46.8	7312	Peak	57.1
	AVG	36.9		AVG	39.4		AVG	51.1
7225	Peak	59.8	5456	Peak	48.9	9143	Peak	51.2
	AVG	50.2		AVG	39.6		AVG	41.5
9031	Peak	50.5	7276	Peak	57.5	-/-	Peak	-/-
	AVG	42.0		AVG	51.7		AVG	-/-
-/-	Peak	-/-	9096	Peak	51.4	-/-	Peak	-/-
	AVG	-/-		AVG	42.2		AVG	-/-

**Plots:**

Plot 1: 1 GHz – 12.75 GHz, horizontal & vertical polarisation (lowest channel)

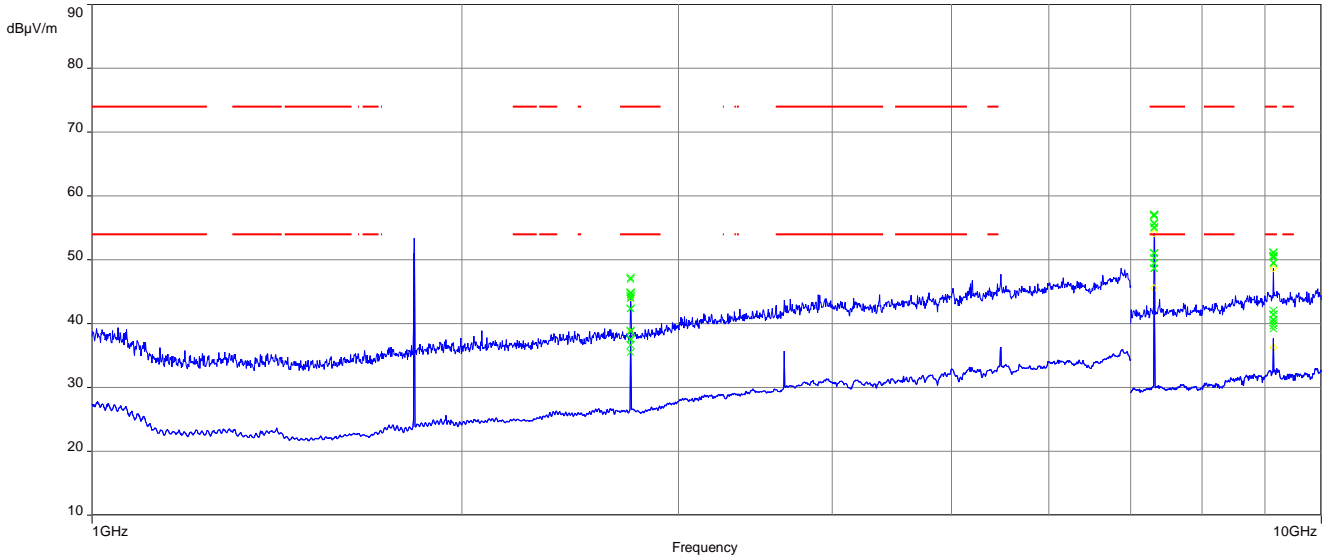


Plot 2: 1 GHz – 12.75 GHz, horizontal & vertical polarisation (middle channel)





Plot 3: 1 GHz – 12.75 GHz, horizontal & vertical polarisation (highest channel)



## 13 Glossary

<b>EUT</b>	Equipment under test
<b>DUT</b>	Device under test
<b>UUT</b>	Unit under test
<b>GUE</b>	GNSS User Equipment
<b>ETSI</b>	European Telecommunications Standards Institute
<b>EN</b>	European Standard
<b>FCC</b>	Federal Communications Commission
<b>FCC ID</b>	Company Identifier at FCC
<b>IC</b>	Industry Canada
<b>PMN</b>	Product marketing name
<b>HMN</b>	Host marketing name
<b>HVIN</b>	Hardware version identification number
<b>FVIN</b>	Firmware version identification number
<b>EMC</b>	Electromagnetic Compatibility
<b>HW</b>	Hardware
<b>SW</b>	Software
<b>Inv. No.</b>	Inventory number
<b>S/N or SN</b>	Serial number
<b>C</b>	Compliant
<b>NC</b>	Not compliant
<b>NA</b>	Not applicable
<b>NP</b>	Not performed
<b>PP</b>	Positive peak
<b>QP</b>	Quasi peak
<b>AVG</b>	Average
<b>OC</b>	Operating channel
<b>OCW</b>	Operating channel bandwidth
<b>OBW</b>	Occupied bandwidth
<b>OOB</b>	Out of band
<b>DFS</b>	Dynamic frequency selection
<b>CAC</b>	Channel availability check
<b>OP</b>	Occupancy period
<b>NOP</b>	Non occupancy period
<b>DC</b>	Duty cycle
<b>PER</b>	Packet error rate
<b>CW</b>	Clean wave
<b>MC</b>	Modulated carrier
<b>WLAN</b>	Wireless local area network
<b>RLAN</b>	Radio local area network
<b>DSSS</b>	Dynamic sequence spread spectrum
<b>OFDM</b>	Orthogonal frequency division multiplexing
<b>FHSS</b>	Frequency hopping spread spectrum
<b>GNSS</b>	Global Navigation Satellite System
<b>C/N<sub>0</sub></b>	Carrier to noise-density ratio, expressed in dB-Hz

## 14 Document history

Version	Applied changes	Date of release
-/-	Initial release	2023-08-08

## 15 Accreditation Certificate – D-PL-12076-01-04

first page	last page
 <p>   <b>Deutsche Akkreditierungsstelle GmbH</b>                      Entrusted according to Section 8 subsection 1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV                      Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition    <b>Accreditation</b>                      The Deutsche Akkreditierungsstelle GmbH attests that the testing laboratory  <b>CTC advanced GmbH</b>                      Untertürkheimer Straße 6-10, 66117 Saarbrücken                      is competent under the terms of DIN EN ISO/IEC 17025:2018 to carry out tests in the following fields:  <b>Telecommunication (TC) and Electromagnetic Compatibility (EMC) for Canadian Standards</b>                      The accreditation certificate shall only apply in connection with the notice of accreditation of 09.06.2020 with the accreditation number D-PL-12076-01. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 07 pages.                      Registration number of the certificate: <b>D-PL-12076-01-04</b>                      Frankfurt am Main, 09.06.2020                      by order Prof.-Ing. (FH) Hans Egner                      Head of Division                      The certificate together with its annex reflects the status at the time of the date of issue. The current status of the scope of accreditation can be found in the database of accredited bodies of Deutsche Akkreditierungsstelle GmbH.  <a href="https://www.dakks.de/en/content/accredited-bodies-dakks">https://www.dakks.de/en/content/accredited-bodies-dakks</a>  <small>See notes on first sheet.</small> </p>	 <p> <b>Deutsche Akkreditierungsstelle GmbH</b>                      Office Berlin                      Spittelmarkt 10                      10117 Berlin                      Office Frankfurt am Main                      Europa-Allee 52                      60327 Frankfurt am Main                      Office Braunschweig                      Bundesallee 100                      38116 Braunschweig                      The publication of extracts of the accreditation certificate is subject to the prior written approval by Deutsche Akkreditierungsstelle GmbH (DAkks). Exempted is the unchanged form of separate disseminations of the cover sheet by the conformity assessment body mentioned overleaf.                      No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation attested by DAkks.                      The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Law Gazette I p. 2525) and the Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union L 218 of 9 July 2008, p. 30). DAkks is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (EA), International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations.                      The up-to-date state of membership can be retrieved from the following websites:                      EA: <a href="http://www.european-accreditation.org">www.european-accreditation.org</a>                      ILAC: <a href="http://www.ilac.org">www.ilac.org</a>                      IAF: <a href="http://www.iaf.nu">www.iaf.nu</a> </p>

**Note: The current certificate annex is published on the websites (link see below).**

<https://www.dakks.de/files/data/as/pdf/D-PL-12076-01-04e.pdf>

or

[https://cetecomadvanced.com/files/pdfs/d-pl-12076-01-04\\_canada\\_tcemc.pdf](https://cetecomadvanced.com/files/pdfs/d-pl-12076-01-04_canada_tcemc.pdf)

16 Accreditation Certificate – D-PL-12076-01-05

first page	last page			
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##### END OF TEST REPORT #####